RESPONSES TO EPA COMMENTS ON JOHNNY M MINE EECA, DRAFT OF DECEMBER 2014
April 16, 2015

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Engineering-1	2.4.2	*NA*	*Section 2.4.2: this section seems to have been copied from the ITASCA report that is attached to the EE/CA report. There is a discrepancy on the typical hydraulic conductivity of a compacted clay liner. The ITASCA report says 1 x 10-7cm/s and the EECA says 1 x 10-6 cm/s. We would agree that 1 x 10-7 is a more typical number, although at this point what will matter is the testing of the actual materials and the modelling of the evapotranspiration (ET) cover. The lower this number the thinner the radon barrier will need to be, but it may increase the sand layer thickness.* ***Please review calculations and adjust if necessary or at least be aware that this will be a possible modification during construction to ET cover radon attenuation goals.***	The hydraulic conductivity values for compacted clay vary with the particular clay properties, the moisture content at compaction, and the degree of compaction, but 10^{-6} to 10^{-7} cm/s are certainly within the range typical of most clays. The hydraulic conductivity cited in Itasca report (top of page 3) is $1.9x10^{-8}$ m/s or 1.9×10^{-6} cm/s, which is consistent with the value stated in section 2.4.2 of the draft EE/CA. In Section 5.3 of the EE/CA, Hecla addresses the function of the cover in radon attenuation and states that the specifics of cover design (including the properties and thicknesses of layers) will be addressed in the planning phase of the removal action. Because the mine-related material (MRM) source terms are relatively low compared with those typical of uranium tailings, the cover thickness and composition will be driven primarily by limiting water infiltration rather than radon attenuation.
Engineering-2	2.6	12	*It is unclear how the quantities were calculated for each of the cleanup criteria. For example in the designated areas, how deep will the cleanup need to be? Are some areas deeper than others? Figures 6 and 7 do not show depths. Are the excavation depths an average over a certain area?*	Section 3.5 of the Site Investigation Report (SIR) addressed estimation of volumes of MRM. Estimates were based on field radiological investigations and utilized the volumetric tools within AutoCAD Civil 3D® software. A specific reference to the SIR will be added to Section 2.6.

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			When calculating the volume of contamination, is the depth affected by the cleanup criteria or just the area, or is it both? Some areas are in deep arroyos; has consideration been given to the difficulty of excavation in the arroyos? ***Please provide additional information and clarification for the above.***	In developing the cost estimates for the removal alternatives, Hecla took into account the type of equipment and pathways of travel to remove MRM from locations with restricted access such as arroyos where dozers, front-end loaders and excavators would be needed; scrapers could excavate and haul MRM from more open areas.
Engineering-3	Section 3		*The conceptual model discussed in the section and shown on Figure 8 does not address surface water transport during rain events, and the impact on downstream receptors. Also for the onsite disposal alternative, two potential sites are identified. What is the area of each site and to what depth will the consolidation and disposal cell be excavated? Also, shown is a 3 ft. sandy cover. Where will this material come from? On-site or off-site? Based on our knowledge of the Site, there is a limited amount of appropriate sandy material present. Have borrow areas for sand and rock been identified, and tested "clean", as excavation at the disposal site may not provide the amount of material required?* ***Please provide additional information and clarification for the above.***	Figure 8 shows water erosion as a primary release mechanism for primary sources. Section 3.13 also discusses the primary release mechanisms for the primary sources. As demonstrated in the streamlined risk evaluation (Section 3.1.6), radon and external gamma radiation due to radium-226 in mine-related materials are the dominant health risk pathways within the project area. Risks from other pathways and COPCs are generally negligible within the project area, thus unlikely a health risk off the project area. Uranium is known to be somewhat soluble under oxidizing conditions and some leaching of uranium into local alluvial groundwater systems could occur, if present. However, an alluvial aquifer is not present in the project area. Therefore, this pathway is incomplete. The amount of uranium currently available for such leaching into offsite alluvial aquifers is very small and would not measurably impact regional groundwater quality in the context of a much larger alluvial groundwater system.

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				There are two potential on-site repository locations, C North and C South, shown on Figure 14. The exact footprint and dimensions will depend on the actual volume of MRM, but C North is estimated to cover up to approximately 10.5 acres with a capacity up to 442,000 cubic yards. C South would have an area of up to 7.8 acres with capacity for approximately 243,000 cubic yards. For estimating purposes, the volume of MRM was 499,921 loose cubic yards, or approximately 417,000 cubic yards compacted in place. Both locations can be expanded for increased capacity, if needed. The depth of excavation for each location and within each location varies with the terrain and the geology. At both C North and C South, the lower sandstone sets the depth limit for repository excavation. This sandstone dips eastward at approximately 4%, so the depth of excavation would increase from west to east. At least two feet of Mancos shale would be left in place over the lower sandstone to serve as a natural liner. The average excavation depth would be approximately 10 feet at both C North and C South. An upper sandstone, approximately two feet thick, covers C South at shallow depth and exists in the east half of C North. This upper sandstone and the lower sandstone contain enough durable rock to satisfy riprap and rock mulch needs for either repository site. All earth materials needed for repository construction would come from on-site sources, most

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				if not all from excavation to create the consolidation and disposal cell of the repository. This is discussed in Section 5.1.2 At C North there is abundant eolian sandy soil (SM, SP-SM, SP) blanketing the east half of the repository footprint, with additional sources to the east. Both C North and C South have up to 10 feet of clay shale (Mancos) that would be excavated to create the repository cell. If needed, additional borrow locations for clay and sand can be developed on site in the west half of Section 18, within the footprints of areas where removal of MRM exposes clean soil. Once the removal action has been selected, Hecla will investigate the selected repository area in more detail for identification and quantification of borrow soils.
Engineering-4	Section 5.3.2	25	*The discussion on the ET cover modelling, although understood to not be a final design, should discuss how the slope of the final cover will impact the time and amount of rainfall that will infiltrate. For example 5:1 slopes will runoff faster than a 10:1 (the range shown on Figure 15). Additionally, assuming 1.1 x10-3 cm/s conductivity of the sand layer may not be conservative but just the opposite. A lower conductivity would result in a longer retention of infiltrated water and thus could result in more infiltration. The same could be true for the conductivity of the clay layer. By assuming a conductivity of 1.3 x 10-4 cm/s, the model*	The objective of the infiltration modeling in the EE/CA phase was to demonstrate that the concept of an on-site repository constructed with on-site earth materials was feasible from both technical and cost perspectives. ITASCA's modeling (ITASCA 2014 reference in the EE/CA) conformed to this objective. Trade-off studies for optimizing cover slope, length, and cover soil hydraulic conductivity are appropriate for the planning phase, after the selection of the removal alternative has been made. Hecla understands that flatter slopes retard runoff rates, others factors being equal. Flatter slopes also benefit vegetation success and generally result in lower erosion rates, so these factors must be taken into account, as well. Cover soil hydraulic

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			will calculate infiltration and transpiration, whereas a lower conductivity would not allow infiltration or transpiration at the same rate. ***Please review design calculations and provide additional information and clarification for the above.***	conductivity is a function of grain size distribution, soil clay mineralogy, and compaction, of which only the latter can be influenced in design and construction for any given soil. These factors will be investigated and evaluated further during the planning phase of the project.
Engineering-5	NA	NA	*How was the period of 12 years selected as the time period for inspections?* ***Please provide rationale.***	The 12-year period is the time typically cited by the New Mexico MMD, based on its experience with other New Mexico mine reclamation, for demonstration of vegetation success in semi-arid environments, with yearly inspections to evaluate revegetation progress.
Engineering-6	Section 5.4.3		*There is good consistency between each of the estimates, therefore the estimates represent a fair comparison of the alternatives. However, based on our experience, it appears that some of the $/unit values are low. For example a construction superintendent for ~$51/hr is low and does not take into consideration travel and per diem for a remote site like this. I also believe that the $/unit values for excavation and transport are low for a site like this where equipment and operators will not be readily available. Also, there should be cost associated with drilling and geotechnical soil characterization at the potential disposal sites and borrow sites that are not included in the cost estimate.* ***Please review projected budget numbers/rates and provide additional information and clarification for the above.***	The unit costs are drawn primarily from the 2014 R.S. Means Heavy Construction Cost Data, as referenced on the cost estimate sheets. This reference is widely used in both mining and civil construction work. Experienced operators and superintendents are available in the area. Geotechnical investigations to supplement the information provided in the SIR, will be done in the planning phase, so they are not included in the construction phase cost estimate
Engineering-7	Table 3	Tables -6	*There are 2 values for Ksat at 95% compaction. We are assuming one is*	ATSM 5084 Saturated Hydraulic Conductivity: Falling Head Rising Tail: (Flexible Wall) was used.

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			beginning of test and one is end of test, but it is not clear. Also how were these tests run? What ASTM test was followed? There is a significant change in the Ksat for a very minor change in density. *What is the explanation for this significant change? It appears that at the beginning of the test, the samples may not have been saturated.* ***Please review procedure and results, and provide additional information and clarification for the above.***	Samples were saturated after compaction and before testing. On Table 3, note that the two sets of K_{sat} values are related to two different moisture contents at compaction. Under the heading K_{sat} compacted to 95% maximum dry density, the samples on the right were compacted at 4% higher moisture content than the samples on the left, and the former have about one order of magnitude lower K_{sat} than the latter, showing that it will be beneficial to compact the shale clay at moisture contents wet of optimum. The results also show that increasing the compaction from 90% to 95% decreases the K_{sat} by at least an order of magnitude. This information is important in evaluating the suitability of the shale clay for use in the cover and for setting the specific compaction parameters to be included in the construction specifications.
Engineering-8	Figures	Figures-5	*Figures (general): the figures are hard to compare, as they all have a different scale, and the photos used as background are difficult to see or are unreadable.* ***Please standardize scales and address resolution issues.***	Each figure has a scale appropriate for the area covered by the figure and the content of the figure. The scale of each figure is clearly shown. Without altering their size or context, we cannot assign a standard scale to all the figures. The same is true in terms of assigning a common geographic reference point to all of the figures. The figures will be revised such that the scales have common units. We will address the figures that EPA identifies as having poor resolution if possible.

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Engineering-9	Figure 5		*Figures (specific): it would seem based on figure 5, that sampling of the arroyos and ditches as they cross NM605 would be a reasonable assumption to show that no contamination has left the site. Also, figure 2 shows the historic drainage canal; however there appears to be no sampling in this area. Since this was an unlined ditch, it would seem reasonable to assume that contamination would be in this area, as significant discharge occurred through this ditch. Also, the gamma exposure rates in that area seem to be elevated, yet no samples were taken and no excavation is indicated in that location. In the drainage areas, contamination may be at depth and covered by clean soil over time and thus did not show up on the gamma survey, so sampling is needed there.* ***Please provide detailed rationale on why these areas were not sampled and fully characterized. If this was an unintended omission, this data gap must be filled.***	A Site Assessment Plan (SAP) was included as Appendix B to the AOC. The SAP was designed to provide sufficient information to allow development of the EE/CA. The results were reported in the Site Investigation Report (SIR), which was approved by the EPA. The project area, as described in Appendix B of the AOC, does not include the ditches where they cross HWY605. Therefore, an investigation was not conducted there. Regarding Figure 2, it is unclear as to what EPA means by “historic drainage canal”. Figure 2 shows both the historic discharge pipe footprint and the original drainage canal. No elevated gamma measurements were observed along the original drainage canal. The selection of soil sampling locations was driven by results of the gamma survey, as prescribed by the AOC. There were no perceived or actual data gaps identified during the approval of the SIR. The volume estimates and analysis of remedial alternatives developed in the EE/CA are scalable and not dependent on the postulated presence of small amounts of buried contamination not detected with gamma surveys during the site investigation. It is clear from the risk assessment that external

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				gamma radiation is the dominant source of health risks for outdoor exposures and small amounts of buried material that could not be detected with gamma surveys would not pose a health risk. If such contamination is buried by aggradation of sediments as postulated, shielding of external gamma radiation would only increase over time. With respect to indoor radon exposure scenarios, radon intrusion is not a plausible concern because a house would not be built at the bottom of a runoff collection ditch or arroyo. Additional information regarding the cleanup of mine-related material within the project area that exceed PRGs will be addressed during remediation, as sampling will be an integral component of remediation validation.
Radiological-1	NA	NA	*Federal guidance compliance: the EE/CA fails to reference and be compliant with OSWER 9255.6-20, "Radiation Risk Assessment at CERCLA Sites, Q & A", dated June 2014. This document presents the most current guidance by the EPA for radiological sites. The purpose of this document is to describe how to analyze levels of radioactive contamination and to explain how to assess risks from radiological contamination as part of a remedy for CERCLA sites. Question 16 of this document provides clear direction that RESRAD is not the preferred code to assess risk at CERCLA sites. Instead, EPA requires*	The AOC specified following the 1993 EPA guidance for "non-time-critical" removal actions and development of an EE/CA. This guidance calls for a streamlined risk evaluation. The referenced 2014 guidance (EPA, 2014a) was not published at the time the AOC became effective, and appears intended for a full-scale baseline risk assessment as part of an RI/FS process under CERCLA. In developing this response, we have observed applicable elements of the EPA's 2014 risk assessment guidance in terms of consistency with a streamlined risk evaluation as described in the EPA's 1993 guidance for development of an EE/CA.

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			the use of the PRG Calculator for this assessment. This position is based on the risk assessment approach for radionuclides used in the PRG calculator is consistent the EPA's approach for chemical risk assessment. Whereas PRG calculator estimates the cumulative risk based on exposure to a steady state concentration over 30 years, RESRAD calculates the risk for each year. By using the conceptual model employed by RESRAD to calculate risk, the result may be inconsistent with the assumptions used in the chemical risk assessment. However, the OSWER guidance document states that if there is a reason on a site-specific basis for using another model, like RESRAD, justification should be provided and a comparative analysis using PRG calculator included. ***Please provide revisions using the PRG calculator or a rationale and justification for continued use of RESRAD to demonstrate compliance with the referenced guidance document.***	Risks modeled using the EPA's online PRG Calculator for Radionuclides (PRG Calculator) (EPA, 2014b) were compared for similar receptor scenarios to RESRAD results as presented in the draft EE/CA. Site-specific input parameters for PRG Calculator were selected for equivalence or close approximation to RESRAD input parameters. Because PRG Calculator does not model radon risks due to radium-226 in soils (Walker, 2015), this pathway was turned off in RESRAD for this comparison. Default parameters for both modeling codes were used in cases where applicable information was unavailable. Default exposure durations were used in both codes for consistency with EPA guidance (EPA, 1991; EPA, 2014c). A primary difference between the RESRAD and PRG Calculator modeling codes is that RESRAD models environmental transport and depletion of the source term over time (due to leaching and soil erosion), whereas PRG Calculator assumes steady state conditions. Both codes integrate risks over the specified lifetime exposure duration, but RESRAD provides respective risks at various specified reporting times. RESRAD generates dose but not risk estimates on an annual basis (millirem per year) (Yu et al, 2001). Although PRG Calculator is preferentially recommended in the EPA's 2014 risk assessment guidance, the RESRAD code appears more consistent with this same guidance in certain respects. For example, RESRAD allows determination of the approximate time of maximum

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				excess cancer risk, and models dose or risk from inhalation of radon and its decay products due to emanation of radon from radium in soils. Both issues are discussed in the EPA's 2014 risk assessment guidance and the PRG Calculator does not have these modeling capabilities (Walker, 2015). The RESRAD modeling results are provided in Figures 1 (Area A) and 2 (Area C) at the end of this document. Each figure depicts model-predicted excess cancer risks over time by dose, pathway, and radionuclide. The total risk based on PRG Calculator modeling is also depicted in these figures for comparison. In general, results for each modeling code are essentially equivalent, though maximum RESRAD risk results for residential scenarios were slightly higher due to 1) greater outdoor occupancy assumed for a resident rancher (versus PRG Calculator defaults for a generic residential scenario)[1], and 2) a slightly greater default exposure duration (30 years) is assumed in RESRAD. Because 1) RESRAD models the expected changes in excess risk over time and 2) the site-specific comparisons presented in this assessment indicate that maximum risk estimates generated with RESRAD do not underestimate temporally constant estimates generated with the PRG Calculator,

[1] This particular difference in input parameters for the two modeling codes was intentional and was limited to residential scenarios to evaluate differences in risk for slightly different indoor/outdoor occupancy factors for the resident rancher scenario assumed for the site, versus the PRG's generic default resident scenario. The experiment shows that differences are relatively small.

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				RESRAD modeling is considered more appropriate for evaluating long-term risks at this site.
Radiological-2	Figures 9&10		*Risk estimates: Figures 9 & 10 present the risk estimates generated using RESRAD for the Site. These figures depict a dramatic fall-off in risk at about year 800, which is not explained in the text.* ***Please provide additional information and clarification for this effect if you wish to continue using the RESRAD model. See previous comment.***	Excess risk from all radionuclides and pathways declines rapidly after about 800 years as radioactive contaminants approach complete depletion from surface soils within the modeled area due to soil erosion, leaching and radioactive decay. This statement will be added to the relevant text in the EE/CA.
Radiological-3	NA	NA	*Proposed cleanup criterion: the EE/CA does not present a proposed cleanup criterion, but instead estimates the cost associated with three potential cleanup criteria; 5 pCi/g above background, 2.5 pCi/g above background, and background. Further, there is no discussion on how the Ra-226 concentrations were arrived at. There is clear discussion on CERCLA risk value calculations and how they relate to the assumptions for the three potential receptor groups, all of which is reasonable. EPA believes that a proposed cleanup criterion for each of the proposed potential receptor groups is an integral part of this EE/CA.* ***Please prepare a proposed cleanup criterion based upon a proposed risk from the use of the PRG Calculator (preferred) or RESRAD (with justification) for each of the potential receptor groups.*** *Further, these calculations should compare risk using both the default values in PRG Calculator or*	There is no mention of establishing cleanup criteria in the 1993 EPA guidance for "non-time-critical" removal actions. The only requirement in this guidance document is to recommend Applicable or Relevant and Appropriate Requirements (ARARs). The CERCLA acceptable risk range was identified as a potential ARAR. However, the following language has been added to a PRG Section of the EECA: "Preliminary Remediation Goals (PRGs) for soils within Areas A and C were calculated for each receptor scenario using the EPA's PRG Calculator for Radionuclides (EPA, 2014b). Consistent with the rationale and criteria used to determine PRGs for soil in the EPA's Five-year Plan for remediation of uranium properties within the Grants Mineral Belt (EPA, 2010a; Weston, 2009), a bounding risk value of 3×10^{-4} was adopted for determination of PRGs for soil within the Johnny M Project Area. Results of this modeling (Table 3) indicate that PRGs for the most conservative receptor scenario (resident) and most limiting (restrictive) radionuclide (radium-226)

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			RESRAD (with justification), and site-specific values representative of the Johnny M site. Cost estimates may need to be amended if the cleanup values are different than those discussed above.	are consistent with the 2.5 pCi/g above background soil cleanup level adopted by the EPA for remediation of uranium properties within the Grants Mineral Belt (Weston, 2009). Hecla plans to use the 2.5 pCi/g of radium-226 above background for areas outside of those addressed by ICs. For areas addressed by ICs, Hecla plans to meet or exceed one of the alternative PRGs in Table 3." In response to EPA's request, a section has been added to the EE/CA in which PRGs for soils for each receptor scenario were developed using PRG Calculator. The calculated PRG for radium-226 in the residential scenario in both areas is consistent with the 2.5 pCi/g above background concentration assumed in one of the volume estimation scenarios presented in the EE/CA. This value was selected based on data provided in Appendix B of "Quality Assurance Sampling Plan for Grants Mineral Belt Structures Assessment Cibola and McKinley Counties, New Mexico," (EPA, 2010). Background was selected to provide an upper bound of the volume estimate. The UMTRCA standard, 5 pCi/g radium-226 above background, was selected to provide a lower bound of the volume estimate. 2.5 pCi/g radium-226 above background was selected to provide a volume estimate based on the expected cleanup criterion for a residential scenario.

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				A table of PRGs (to be included in the EE/CA) for common receptors developed using the PRG Calculator is provided below.

References:

Yu, C.; Zielen, A.J.; Cheng, J.-J.; LePoire, D.J.; Gnanapragasam, E.; Kamboj, S.; Arnish, J.; Wallo III, A.; Williams, W.A.; and Peterson, H.. 2001. User's Manual for RESRAD Version 6. Environmental Assessment Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439.

U.S. Environmental Protection Agency (EPA). 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, "Standard Default Exposure Factors". Interim Final. OSWER Directive 9285.6-03. U.S. EPA, Office of Emergency and Remedial Response, Toxics Integration Branch. March 25, 1991.

U.S. Environmental Protection Agency (EPA). 1993. Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA. U.S. EPA, Office of Emergency and Remedial Response. August, 1993.

U.S. Environmental Protection Agency (EPA). 2010. Quality Assurance Sampling Plan for Grants Mineral Belt Structures Assessment Cibola and McKinley Counties, New Mexico, January, 2010.

U.S. Environmental Protection Agency (EPA). 2014a. Radiation Risk Assessment at CERCLA Sites: Q & A. Directive 920.4-40. Office of Superfund Remediation and Technology Innovation. May, 2014.

U.S. Environmental Protection Agency (EPA). 2014b. Preliminary Remediation Goals for Radionuclides – PRG Calculator. November 2014. http://epa-prgs.ornl.gov/radionuclides/

U.S. Environmental Protection Agency (EPA). 2014c. Preliminary Remediation Goals for Radionuclides – PRG User's Guide. November 2014. URL: http://epa-prgs.ornl.gov/radionuclides/

Walker, Stuart. 2015. Personal communication with Stuart Walker, the EPA subject matter expert on radiological risk assessment at CERCLA sites and use of the PRG Calculator for radionuclides. March 23, 2015

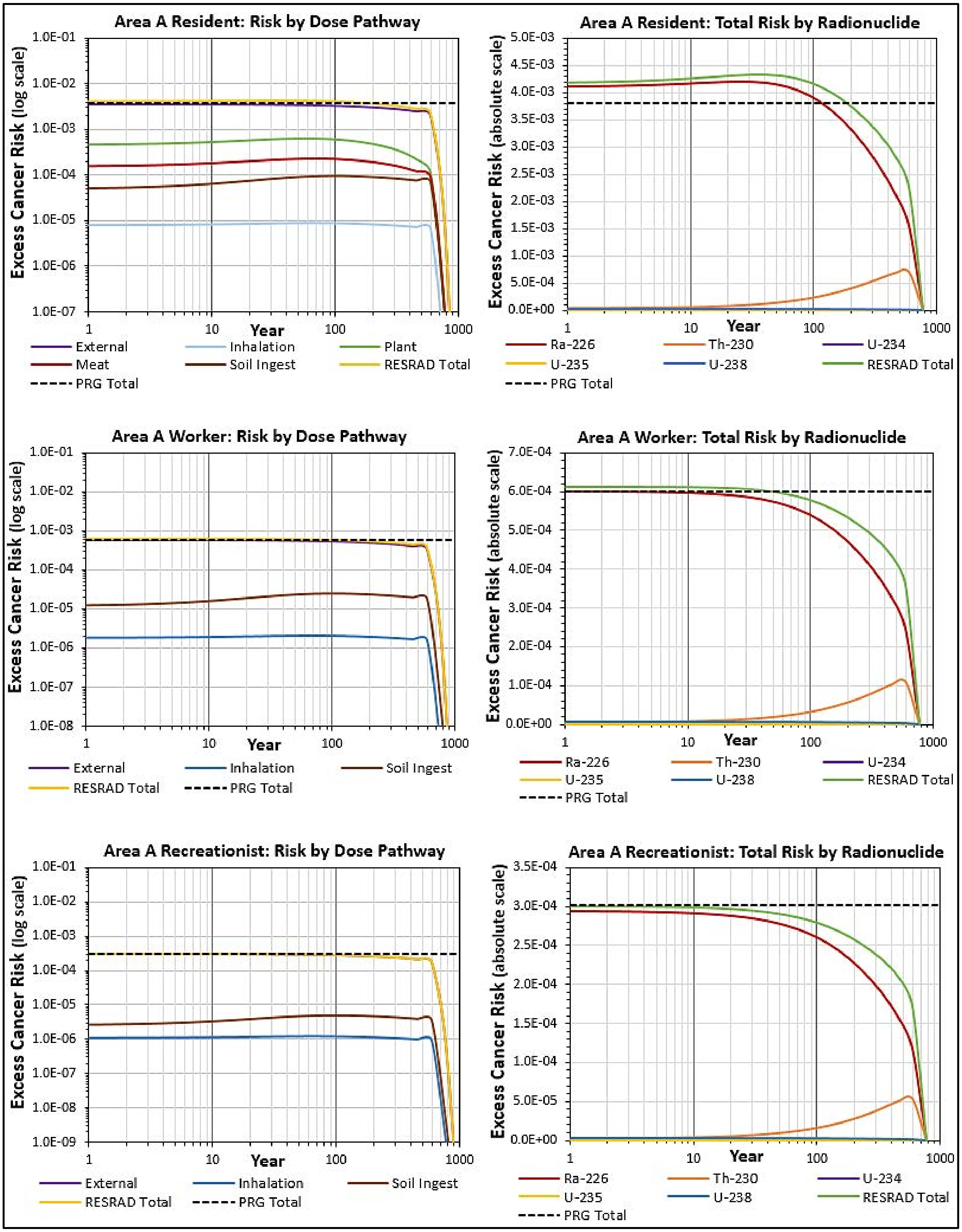

Figure 1: RESRAD modeling results: lifetime excess cancer risk by receptor scenario for Area A.

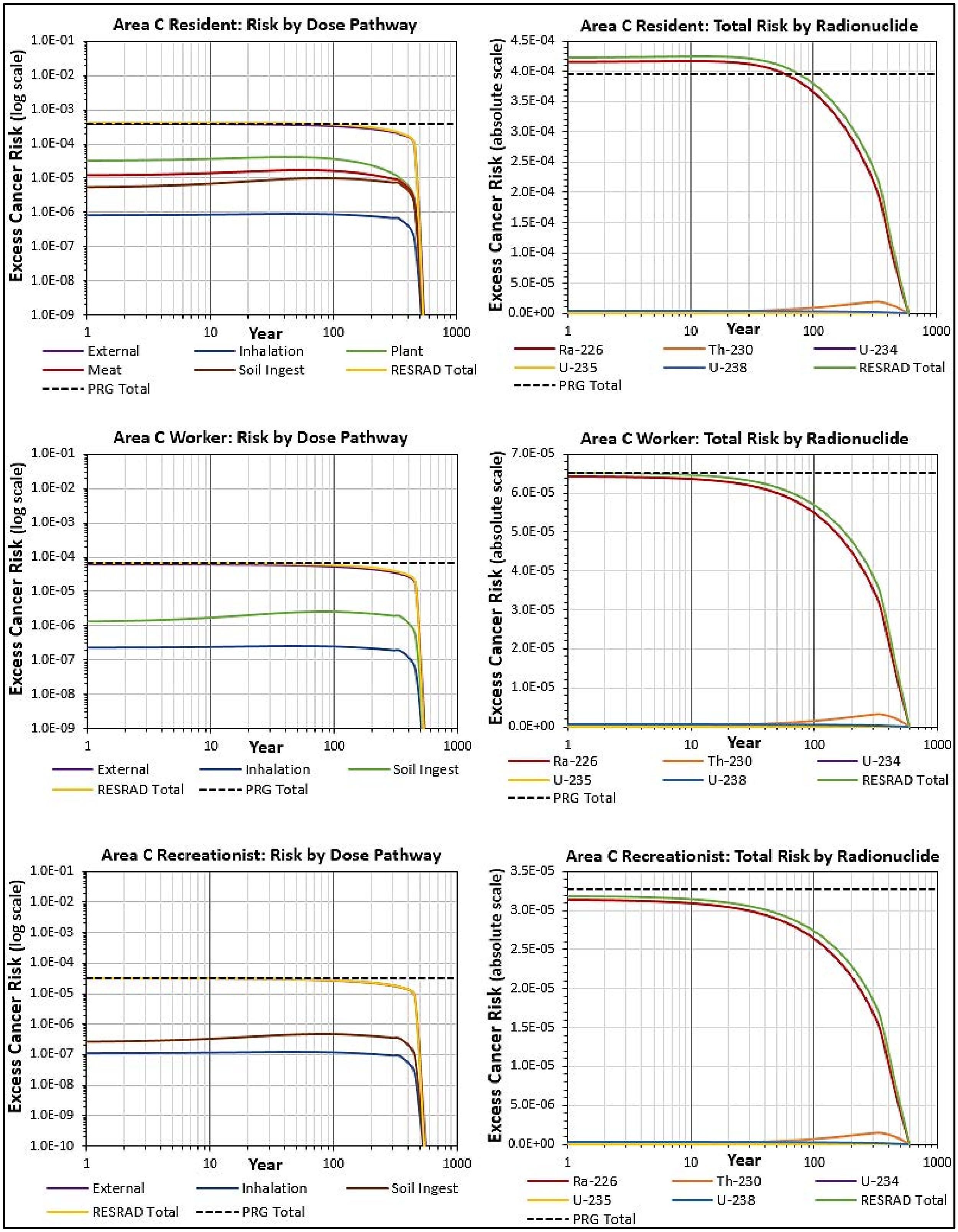

Figure 2: RESRAD modeling results: lifetime excess cancer risk by receptor scenario for Area C.

Table 3: Calculated total PRGs for soil by project area, receptor scenario and radionuclide.

Isotope	Area A Resident PRG (pCi/g)	Area A Worker PRG (pCi/g)	Area A Recreator PRG (pCi/g)	Area C Resident PRG (pCi/g)	Area C Worker PRG (pCi/g)	Area C Recreator PRG (pCi/g)
Ra-226+D	2.9E+00	1.6E+01	3.2E+01	2.8E+00	1.6E+01	3.1E+01
Th-230	4.0E+01	1.1E+04	2.9E+04	4.0E+01	1.1E+04	2.9E+04
U-234	4.9E+01	1.8E+04	3.5E+04	4.9E+01	1.8E+04	3.5E+04
U-235+D	2.7E+01	2.4E+02	4.7E+02	2.7E+01	2.3E+02	4.6E+02
U-238	5.4E+01	2.0E+04	3.9E+04	5.4E+01	2.0E+04	3.9E+04